# ABSTRACT OF A THEORY AS TO THE CAUSE OF EARTHQUAKES.

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It is clear that, as regards their causes, volcanoes and earthquakes are to be grouped together—with the exception of small earthquakes due to purely superficial causes. It is also clear that water or steam plays an essential part in all such seismic phenomena.

The earth's temperature rises as we descend, attaining at moderate depths a degree far exceeding that required for the transformation of water into steam. If such a transformation took place suddenly, a violent explosion would necessarily be the result, and seismic effects would be produced.

The difficulty is to account for the preliminary accumulation of liquid water in regions too hot for its existence except in the form of steam. For clearly the water must first penetrate into these regions, and then be violently vaporised.

A gradual infiltration of water, through the ocean bed for example, is evidently quite incapable of satisfying the conditions, and would besides fail to account for the invariably intermittent character of seismic activity. All the conditions, however, seem to be met by the following very simple hypothesis. Consider first a volcanic and second a non-volcanic region.

First, a volcanic region. At some depth below the surface there is a hot focus; and near the surface we have water and

moist rocks. Between these regions there must be a solid barrier free from moisture, free because of its high temperature. Now let a communication be established between the highest and lowest regions by means of a crevice forming in the intermediate barrier. This will of necessity be accompanied by a pulverisation of rocks, and fragments, more or less saturated with water, will almost certainly fall from the surface crust down into the hot volcanic depths below. Thus liquid water will be rapidly conveyed to regions so hot as to cause it rapidly to vaporise with all the effects of an explosion.

Many geological and seismological facts fit naturally into this hypotheses. The faulted condition of rocks shows that crevices do form in the manner supposed. Then if the falling fragments reach regions which are moderately hot, the transformation of water into steam will take place gently. On the other hand, if they fall into highly heated regions amongst molten rocks, the bubbling steam may raise the whole fluid mass; just as the escaping carbonic acid gas causes champagne to effervesce. Between these two extremes all other cases fall.

Second, a non-volcanic region. Even though there is no volcanic centre, yet it is admitted that we have subterranean heat everywhere. This, in combination with faulting, will lead to very similar effects. Many facts, which observation has established, seem to admit of ready explanation according to this hypothesis. For example, pronounced seismic activity in recently faulted countries; the elongation of an epicentre parallel to shore or mountain ridge, that is, in the probable direction of faulting; the occurrence of earthquakes along the known lines of great faults, as in Western Switzerland from the Lake of Constance to the Lake of Geneva; the intermittent character of earthquake shocks in countries liable to seismic action; and, perhaps most important of all, the propagation of the point of origin of a shock along a fault. This last effect will take place when a fault gradually widens out in

a given direction, the successive earthquakes due to the falling in of saturated rocks originating at points succeeding each other along this direction. Thus, in 1811, a series of earthquakes beginning at the mouth of the Mississippi worked up in the course of a year to the Great Lakes of Canada.

In the discussion which followed, Mr. Milne remarked that he did not see the necessity of requiring fissures for the penetration of water into the crust of the earth, since the remarkable experiments of Daubrée show that by capillary action water can soak through rocks against high steam pressures.